On the Pupation of the Nymphalidæ

IN NATURE, vol. xvi. p. 502, I called attention to some observations and experiments of mine on the pupation of several species of *Nymphalidæ* and *Pieridæ*, the results of which were: (1) That, in the species referred to, a connection (larvo-pupal ligament) exists between the larva-skin and the chrysalis which is the sole support of the suspensus chrysalis during the final process of pupation, namely, during the extraction of its tail from the larval skin and fastening the anal hooks in the supporting silk; (2) That this ligament is not confined to the *Suspensi*, but exists also in species of the *Succincti* where it has not the same function to perform; and (3) That nevertheless, in these latter cases, when other support is withdrawn by cutting the girdle before pupation, this ligament is capable, in the majority of cases, of fulfilling the same office as it does in the *Suspensi*.

These views have recently received important confirmation and extension at the hands of Mr. W. H. Edwards, of West Virginia. I refer in the first place to a paper of his in the *Canadian Entomologist* for December, 1878, which is reprinted in the *Entomological Monthly Magazine* for the present month. Here Mr. Edwards describes the ligament as found by him in *Grapta interrogationis* and *Danais archippus*. In the latter it is black. Of the former Mr. Edwards writes: "When I lifted the flap of skin entirely clear of the struggling segments, and cut it off a little below the tail, the bendings and contortions were not interrupted by my interference, nor was the effort to reach the silk in the least abated. Held firm by the stretched ligament, which was in plain view, the body rose, and the tail, which had got well outside the padded skin and was, before complete extrication, bent backward, now bent forward, and by the upward swing, was brought exactly to the silk. Several times as I was lifting, the skin and chrysalis together were dislodged, and fell into my hand. Then by drawing the skin back the ligament was exposed, and it was distinctly seen that it was attached to the chrysalis by the pointed ends of the ridges before mentioned and that there was no other connection between skin and chrysalis." As regards the second and third points mentioned above, Mr. Edwards writes to me as follows:—"I experimented on *Papilio ajax* and *P. asterias*, also following your illustration with Pieris, and was successful in discovering the membrane in both species. *Ajax* has the terminal part of the chrysalis remarkably short, but although I cut the band and let the larva hang, the chrysalis generally succeeded in reaching the button of silk. So with *Asterias*, in which the terminal joint is longer. I have no doubt all the Papilionidæ possess this membrane, and probably the Satyridæ."

We have now the existence of the ligament demonstrated in three species of *Suspensi*, viz., *V. urticæ*, *G. interrogationis*, and *D. archippus;* and in three or four *Succincti*, namely, *Pieris brassicæ*, *Papilio ajax*, and *P. asterias*, and probably also in *A. cardamines;* all of which latter also pupate more or less successfully when artificially converted into suspensi by cutting the loop. To the case of *A. cardamines*, which, when pupating as an artificial suspensus, does not remove the tail of the chrysalis from the pocket of the old larva-skin, there is a parallel in *Pyrarga egeria*, and perhaps also in *Epinephele janira*, in regard to the former of which Mr. Newman states ("British Butterflies," p. 85):—"The skin of the caterpillar always remains attached to the anal extremity [of the chrysalis], even after the butterfly has escaped." In reference to *Janira* he writes (*op. cit.*, p. 92):—"Three of my specimens changed to chrysalids," &c.; "in two instances the skin of the caterpillar remained, enveloping the anal extremity, so that the chrysalis could not be suspended; in the third it hung for a time from a blade of grass, the skin still enveloping the anal extremity, but attached by its anal hooks to silken threads on the grass."

Mr. Edwards promises further researches during the coming season, for which he has favourable opportunities in his locality, and I think we may confidently look for interesting and perhaps important results. The question of rank in the diurnal lepidoptera is one that has been much contested (see Wallace's essay on "The Malayan Papilionidæ," &c., "Contributions to the Theory of Natural Selection," p. 133), and will probably be decided differently, according to the standard of perfection set up; but the question of *derivation* is probably more capable of definite solution, and on this point the suspensory ligament seems well calculated to afford important guidance. In the meantime more extensive observations and experiments are wanted, and will no doubt be afforded by those interested in the subject when their attention has been once directed to the matter.

Milford, Letterkenny, March 26 J. A. OSBORNE

Tides at Chepstow

I AM unable to find any certain record of "exceptionally high tides" at Chepstow. They must be of rarer occurrence than is commonly supposed. A very high one is mentioned as having flooded the lowest parts of the town January 29, 1846; and a very low neap tide is noted in a wharfinger's books, on March 19, 1876. Measurements of these cannot be obtained; but the highest known rise of the tide at Chepstow since the erection of the iron passenger bridge in 1816, has not exceeded fifty feet; and probably has never attained such an elevation even with the conjunction of much fresh water inland, and a stiff S.S.W. breeze.

Fair proof of the accuracy of this statement is afforded in the elevation of the railway bridge that spans the Wye about two miles and a half from its mouth. By the requirements of the Admiralty, a clear headway of fifty feet had to be left above the highest known tide. Besides attention to these requirements, the contractors had to provide approaches to the roadway of the bridge, involving, on the Gloucestershire side, a long and deep cutting through limestone rock, and on the Monmouthshire side a lofty embankment. A very large outlay of money depended on the determination of the "highest known tide," for it regulated the point of suspension for the bridge, and the level of the approaches. Yet, as may be seen in the official report appended to these notes, *forty-four feet* only were allowed for the "rise of the tide." The readers of NATURE may refer for a drawing of the bridge, plans, and a detailed report, to the *Illustrated London News* of July 24, 1852, to satisfy themselves.

Through the kindness of Mr. Henry Gillam, and of Messrs. Miller, the lessees of the salmon fisheries in the Severn and in the Wye, I have received measurements of this day's tidal range in both rivers, taken personally by those gentlemen. Amongst well-known points I cite the height at Portskewitt landing stage, New Passage, on the Severn, 39 feet 3 inches; at Chepstow railway bridge, 39 feet; at Chepstow Passenger bridge, about a quarter of a mile higher up the river, 35 feet.

In the geographical part of Knight's Cyclopædia, article "Chepstow," the rise of water at Chepstow Bridge at high tide is given as "fifty feet, being the greatest tidal rise in Europe."

The highest reliable measurements that I have met with for the tidal rise in the Severn are 47 feet 6 inches, marked on the Portskewitt landing-stage.

For accidental phenomena affecting the tidal levels, I refer to the following extract from the Bristol Tide Book:—

By a careful comparison of the differences of the predicted and observed heights of tide at Bristol with the contemporaneous heights of the barometer, Mr. Bunt found that a depression of one inch in the mercurial column is accompanied by an elevation of fourteen inches, nearly, in the height of the tide. Hence, by observing the state of the barometer a few hours before high water, we obtain the following correction of the height predicted in the tide table:—

When the barometer stands at (Inches.)		Inches.
28 6	Add to the predicted height	20
29 0		14
29 4		8
29 8		3
30 0		0
30 4	Deduct from the predicted height	6
30 8		11

Our highest tides for 1879 are marked in the table as occurring Monday, March 10, and Tuesday, April 8. JOHN YEATS

Chepstow, March 24

P.S.—Through the kindness of the four brothers Miller, I am this morning in possession of measurements of yesterday's tide in the Severn and Wye, taken, by the request of the firm, at distant stations. I enclose one, at Tintern Abbey, taken by Wm. Bowen, a regular correspondent of the Meteorological Department.

March 25

Tintern Abbey, near Chepstow, March 24

MR. ALEXANDER MILLER

DEAR SIR,—As requested, I have taken the height of the flow of tide this morning and find it 15 feet 1 inch above present level

of river, which is about 2 feet 9 inches above summer low-water level.

Yours truly,
WILLIAM BOWEN

The pier master (W. Mants) at Clevedon, near Weston-super-Mare, reports that he timed the rise of the tide there on March 10 from two hours flood, and found that it flowed thirty feet perpendicular in two hours and forty-five minutes. On March 24 the tide rose thirty-eight feet at the Clevedon Pier Head.

J. Y.

Ice Pearls

A PHENOMENON of singular beauty presented itself on the morning of March 24. A patch of meadow land, several acres in extent, had been inundated so far as to leave, pretty regularly distributed throughout, stalks of last year's grass projecting several inches above the surface of the pond. During the preceding night the temperature had been below freezing-point, but the wind which rippled its surface prevented the pool from freezing, while it alternately raised and depressed the stalks of grass. The water thus collected by the bending and rising grass-heads formed into large shining beads of ice which lay at the point of junction of the stalk and the pool. The effect was as if each projecting stalk had unfolded a white flower floating on the water, and when a gleam of sunshine smote the surface of the pool, the effect was resplendent. J. SHAW

Tynron, Dumfriesshire

Unscientific Art

MR. COPPOCK'S explanation (NATURE, vol. xix. p. 484) has occurred also to me; but may I be allowed to remind him that in consequence of the internal construction of the marine barometer (the pipette and the contraction in the tube), when it is sloped the mercury rises and falls very slowly. As it naturally rises and falls at a decreasing rate, if the barometer be sloped for a few seconds it takes a comparatively long time for the mercury to resume its original position. I have just sloped one of Adie's marine barometers at 30° from the vertical, and I find it takes more than ten minutes to recover itself. I do not know what may be the actual practice on board ship, but I cannot but think that a plan which renders a barometer useless for ten minutes to another or the same observer must be an unusual one. JOHN W. BUCK

New Kingswood, Bath, March 28

SCIENCE AND WAR—SIGNALLING BY SUNSHINE

THE use of the heliostat in the field adds one more to the many applications of science made by our soldiers and sailors. Signals by sunshine may be no novelty, but the present Afghan campaign and the Zulu war will henceforth be cited as the first in which the heliostat was employed as an implement of warfare. There can be little question as to its value to the soldier, for it affords at once a ready and far-reaching mode of signalling; but sunshine is an obvious *sine quâ non* to its use. In this country, where the Astronomer-Royal tells us the number of hours of sunshine in the week sometimes does not go beyond the units, the heliostat would furnish but an irregular means of telegraphing, and interruptions in the service would be both frequent and prolonged. But in India, on the other hand, at special seasons, at any rate, sunshine is the rule rather than the exception, and consequently the heliostat furnishes an excellent means of communication which our scientific soldiers have done well to make use of.

Heliostat stations are established at this moment throughout the Khyber Pass, and General Sir Sam. Browne, at Jellalabad, has his orders passed up to him by flashes of light from Peshawur and Ali Musjid. Lord Chelmsford has of late also been furnished with heliostats, in order to provide him with better means of commuication along the Tugela. The plan of working is very simple. The mirror of the heliostat is placed so as to reflect the sun's image to a distant station, and when the instrument has once been set the clockwork arrangement, it need not be said, suffices to maintain the mirror in its proper position. In this way the distant station in question always sees the dazzling ray reflected from the mirror, except when the latter is purposely obscured. The appearance and disappearance of the bright spot or flash constitute the signals. There is no need for any superintendence when once the apparatus has been put in working order, and a trained signalman suffices for the duty. The ordinary Morse alphabet supplies an intelligible code, and no one out of the line of signals can read or understand the message. As a substitute for the dot and dash, which go to make up the ordinary written Morse code, the light is shown for short and long intervals; thus the light shown for a short period followed by a long period signifies A, while B is represented by a long period followed by three short ones; in the case of C, long, short, long, short signals are made in turn, and to form E, the letter most frequently used, the light is permitted to shine for one single short period only.

The intensity of these sunshine signals can scarcely be imagined by any one who has not seen the heliostat in working order, and the distance to which they might be made to travel, could suitable stations be provided, is practically unlimited. But everybody has noticed at one time or another, just before sunset, the light striking vividly against the windows of a house. In this case the burning spot may be seen for miles away, and forms the most striking object in the whole landscape. The heliostat signal is obviously brighter still than this, and the appearance and non-appearance of the light is to be appreciated at ten or twenty miles distant without the aid of telescope or binocular.

Signalling by the aid of a mirror is among the earliest experiments of telegraphy, nor, if we are to believe travellers, is the use of a reflecting surface in this way new in warfare; it is only the heliostat, indeed, which we can claim to have been the first to employ in the field. Several instances are on record of polished metal surfaces being used in this manner by savage nations, and it is but two years ago that the United States forces captured a tribe of Indians to whom the use of the mirror was not unknown. These were the Nez Percés Indians, and, according to latest accounts, they were still confined by the American Government in a camp near Fort Leavensworth, where, however, they were left pretty well to their own devices. According to the *New York Daily Graphic* their chief carried with him a looking-glass, "used to direct military manœuvres in battle, by means of reflected rays of light. Their various significations, however, have never yet been found out by the white man," we are told. These are not likely to have been very complicated. The difficulty, in fact, is not so much in reading light-signals of this kind as to reflect the rays in precisely that direction in which the party for whom they are intended happens to be located. How the chief of the Nez Percés managed to do this with his hand-mirror is rather what "the white man" would like to understand.

One other incident in the history of light-signals deserves to be mentioned. When Admiral Sheriff was stationed at Gibraltar in 1835, he made a series of experiments with a view to employing light as a means of telegraphy. His signals were made by an ordinary toilet looking-glass from his bedroom window, that looked out upon the Mediterranean, and by the aid of this simple apparatus he was enabled to communicate with a friend at Tangiers. His light-signals travelled from "the Rock" right across to the African mainland, a distance of something like twenty miles, and were read and answered without difficulty by his colleague on the opposite shore.

Besides the heliostat, our troops in the field are provided with flags and lamps for signalling by day and night. The flags are made four feet square, so as to be